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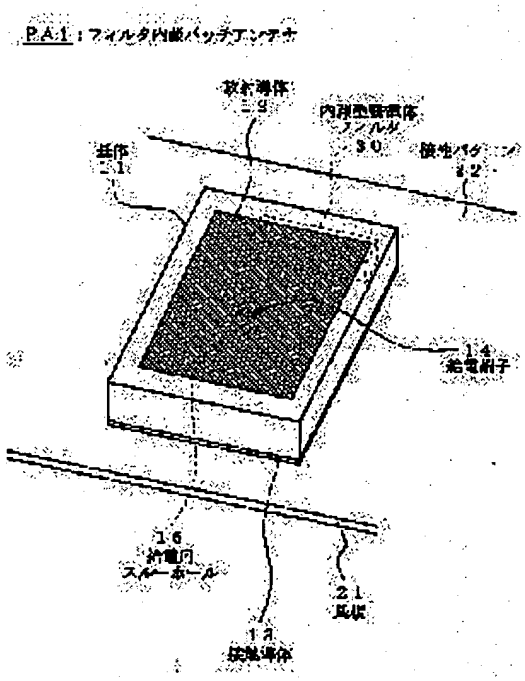
(54) PATCH ANTENNA INCORPORATING FILTER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a patch antenna incorporating a filter by facilitating the miniaturization of the patch antenna to which the filter is added and preventing the deterioration of a characteristic such as the narrowing of a band and the drop of radiation efficiency at the time of miniaturization.

SOLUTION: In an incorporated patch antenna, a substrate constituted of a dielectric material, a radiation conductor installed on one face of the substrate, aground conductor installed on a face facing one face, a feeding through hole feeding power to the radiation conductor and a dielectric filter which has a GND face on a face parallel to the radiation conductor and is installed in the inner part of the substrate are arranged. The feeding through hole and the dielectric filter are electrically connected in the substrate.



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CLAIMS

[Claim(s)]
[Claim 1] A GND side is provided in a field parallel to a conductor. the radiation prepared in one field of a base and the; above-mentioned base constituted with dielectric materials -- the touch-down prepared in the field which counters the conductor and; above-mentioned one side -- a conductor and the; above-mentioned radiation -- the through hole for electric supply which supplies electric power to a conductor, and the; above-mentioned radiation -- The patch antenna with a built-in filter characterized by having the dielectric filter and; which are prepared in the interior of the above-mentioned base, and connecting electrically the above-mentioned through hole for electric supply, and the above-mentioned dielectric filter inside the above-mentioned base.
[Claim 2] With dielectric materials The base and; which are constituted It is prepared in the crevice established in the near part, and the; above-mentioned crevice inside. the radiation prepared in one field of the above-mentioned base -- the touch-down prepared in the field which counters the conductor and; above-mentioned one side -- a conductor and the; above-mentioned radiation -- the above-mentioned touch-down in the through hole for electric supply and the; above-mentioned base which supply electric power to a conductor -- a conductor -- moreover It has a conductor, the dielectric filter of the chip mold formed in parallel, and;. the above-mentioned radiation -- The patch antenna with a built-in filter which most bases of the above-mentioned crevice are GND electrodes, and is characterized by connecting electrically the above-mentioned through hole for electric supply, and the above-mentioned dielectric filter on the interior or the front face of the above-mentioned base.
[Claim 3] claim 1 or claim 2 -- setting -- the above-mentioned radiation -- two or more conductors are prepared -- having -- each radiation -- the patch antenna with a built-in filter characterized by connecting the through hole for electric supply to a conductor.
[Claim 4] It is the patch antenna with a built-in filter characterized by being the duplexer or band splitter with which the above-mentioned dielectric filter treats two or more frequencies in claim 3.

[Translation done.]

* NOTICES *

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2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the slanting perspective drawing showing the patch antenna PA 1 with a built-in filter which is the 1st example of this invention.
[Drawing 2] It is the sectional view of the patch antenna PA 1 with a built-in filter.
[Drawing 3] It is the sectional view showing the patch antenna PA 2 with a built-in filter which is the 2nd example of this invention.
[Drawing 4] It is the structure slanting perspective drawing showing the patch antenna PA 3 with a built-in filter which is the 3rd example of this invention.
[Drawing 5] In the patch antenna PA 3 with a built-in filter, it is the perspective view omitting and showing a base 11.
[Drawing 6] It is drawing showing the equal circuit of the patch antenna PA 1 with a built-in filter.
[Drawing 7] It is drawing showing the equal circuit of the patch antenna PA 2 with a built-in filter.
[Drawing 8] In the above-mentioned example, it is drawing explaining the point of "suppressing property degradation accompanying the miniaturization of the antenna itself."
[Drawing 9] It is the sectional view showing the conventional patch antenna PA 10.
[Drawing 10] It is the front view showing the conventional patch antenna PA 10.
[Description of Notations]
PA1, PA2, PA3 -- Patch antenna with a built-in filter,
11 -- Base,
12 -- radiation -- a conductor,
13 -- touch-down -- a conductor,
14 -- Electric supply terminal,
15 -- Through hole for electric supply,
16 -- Capacitor electrode pattern,
16a -- Internal electrode pattern,
16b -- Capacitor electrode pattern,
17 -- Inner conductor,
18 -- GND electrode,
the object for 19 -- external connection -- a conductor,
21 -- Printed circuit board
22 -- Touch-down pattern,
23 -- Circuit pattern
25 -- Short circuit pin,
30 -- Built-in dielectric filter,
31 -- Chip mold filter,
32 -- Dielectric filter,
41 -- Joint capacity.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the patch antenna with a built-in filter used for mobile communications, LAN (Local Area Network), and ITS (Intelligent Transport System) and ETC (Electronic Toll Collection System).
[0002]
[Description of the Prior Art] Drawing 9 is the perspective view showing the conventional patch antenna PA 10. Drawing 10 is the sectional view showing the conventional patch antenna PA 10.
[0003] the antenna with which the conventional patch antenna PA 10 is indicated by JP,10-145133,A etc. -- it is -- the front face of a base 11 -- radiation -- a conductor 12 and touch-down -- a conductor 13 prepares -- having -- radiation -- a conductor 12 is connected to the mounting substrate 21 by the through hole 15 for electric supply -- having -- touch-down -- the conductor 13 is connected to the touch-down pattern 22 on the mounting substrate 21.
[0004] The base 11 consists of dielectrics, such as a ceramic and resin. resonance frequency and bandwidth -- the dielectric constant of a base 11, thickness, and radiation -- when the specification of an antenna will be decided if it is going to make a patch antenna from general structure since it is determined by the form of a conductor 12, and magnitude, the configuration of the patch antenna PA 10 is decided automatically.
[0005]
[Problem(s) to be Solved by the Invention] the case where the above-mentioned conventional example is miniaturized -- radiation -- bend a conductor 12, slitting is put in, or it is processing preparing a short circuit pin etc.
[0006] moreover -- although there is a merit of being able to install the patch antenna PA 10 in the touch-down pattern 22 -- radiation -- since the principle of making it resonate by the inductance and capacity which become settled in the magnitude of the pattern of a conductor 12 and a configuration is used, when it is going to resonate the signal of a predetermined frequency, there is a problem that the configuration of the patch antenna PA 10 becomes large.
[0007] As mentioned above, since a configuration becomes large, the conventional patch antenna PA 10 has the problem that the miniaturization of the patch antenna PA 10 is difficult. Moreover, in order to miniaturize, it is possible to bend an electrode, to put in slitting or to put in a short circuit pin, but when it does in this way, there is a problem that a band becomes narrow or degradation of properties, like radiant efficiency falls arises.
[0008] The miniaturization of the patch antenna which added the filter is easy for this invention, and it aims at offering the patch antenna with a built-in filter which does not cause degradation of properties, such as narrow-band-izing and decline in radiant efficiency, on the occasion of a miniaturization.
[0009]
[Means for Solving the Problem] the radiation prepared in one field of the base which this invention consists of with dielectric materials, and the above-mentioned base -- with a conductor the touch-down prepared in the field which counters the one above-mentioned field -- a conductor and the above-mentioned radiation -- with the through hole for electric supply which supplies electric power to a conductor the above-mentioned radiation -- it is the built-in patch antenna to which a GND side is provided in a field parallel to a conductor, it has the dielectric filter prepared in the interior of the above-mentioned base, and the above-mentioned through hole for electric supply and the above-mentioned dielectric filter are electrically connected inside the above-mentioned base.
[0010] moreover, the radiation prepared in one field of the base which this invention consists of with dielectric materials, and the above-mentioned base -- with a conductor the touch-down prepared in the field which counters the one above-mentioned field -- a conductor and the above-mentioned radiation -- with the through hole for electric supply which supplies electric power to a conductor It is prepared in the crevice established in some conductors, and the above-mentioned crevice inside. the above-mentioned touch-down in the above-mentioned base -- and the above-mentioned radiation -- it is the patch antenna with a built-in filter to which it has a conductor and the dielectric filter of

the chip mold formed in parallel, and the above-mentioned through hole for electric supply and the above-mentioned dielectric filter are electrically connected on the interior or the front face of the above-mentioned base.
[0011]
[The gestalt and example] of implementation of invention Drawing 1 is the slanting perspective drawing showing the patch antenna PA 1 with a built-in filter which is the 1st example of this invention.
[0012] Drawing 2 is the sectional view of the patch antenna PA 1 with a built-in filter.
[0013] the patch antenna PA 1 with a built-in filter -- a base 11 and radiation -- a conductor 12 and touch-down -- it has a conductor 13, the electric supply terminal 14, the through hole 15 for electric supply, the capacitor electrode pattern 16, and the built-in dielectric filter 30.
[0014] dielectric materials (it is not necessary to restrict to an ingredient with a high dielectric constant as the ingredient) constitute a base 11 -- having -- insulation -- having -- radiation -- a conductor 12 is formed in one field of a base 11 -- having -- touch-down -- a conductor 13 is formed in the field which counters the one above-mentioned field -- having -- the through hole 15 for electric supply -- radiation -- electric power is supplied to a conductor 12. moreover, the dielectric filter 30 -- radiation -- it is the dielectric filter of the TORIPU rate mold which possesses a GND side in a field parallel to a conductor 12, and is formed in the interior of a base 11.
[0015] Furthermore, the through hole 15 for electric supply and the dielectric filter 30 are electrically connected in the base 11 interior. That is, the capacitor electrode pattern 16 is carrying out capacity coupling of the through hole 15 for electric supply, and the dielectric filter 30.
[0016] the capacitor 41 shown with a broken line here -- the object for radiation -- it is the joint capacity between a conductor 12 and the GND electrode 18.
[0017] Moreover, although the patch antenna PA 1 with a built-in filter is used being mounted in a printed circuit board 21, most parts which mount the patch antenna PA 1 with a built-in filter are the touch-down patterns 22 in that case. By doing in this way, the property of an original patch antenna is securable. That is, originally a patch antenna is constituted on a large GND side.
[0018] In addition, in the above-mentioned example, the dielectric materials used are composite materials of a ceramic (such mixture, such as a KODI light, forsterite, an alumina, a textile-glass-yarn ceramic, and a titanium oxide system ceramic), resin (polytetrafluoroethylene, polyimide, bismaleimide, triazine, liquid crystal polymer, etc.), and a ceramic and resin etc., and have insulation. A dielectric constant or the mixing ratio of a composite material is chosen suitably.
[0019] Moreover, the conductors in the above-mentioned example are gold, silver, copper, palladium, etc. When choosing these ingredients, what fulfills a necessary minimum property for antenna property reservation is chosen. The elements which are effective against especially an antenna property are tandelta of an element assembly, and the dielectric constant of an element assembly.
[0020] the ceramic substrate in which the base 11 was formed by the sheet method of construction, the printing method of construction, or the metal mold shaping method of construction, a resin substrate, or the substrate with which it consists of composite material of a ceramic and resin -- it is -- radiation of the front face of this substrate, or the interior -- a conductor 12 and touch-down -- the conductor 13, the internal GND electrode 18, the capacitor electrode pattern 16, and the electrode pattern that constitutes the dielectric filter 30 are formed of technique, such as printing, a spatter, or etching.
[0021] Moreover, when establishing the through hole 15 for electric supply in a green sheet, a hole is made in that green sheet with a drill, laser, etc., and an electrode is formed in the interior of this hole that was able to be made by restoration or plating. In this case, as long as it is multilayer structure, it may be made to perform the above-mentioned processing for each class.
[0022] In the above-mentioned patch antenna PA 1 with a built-in filter, since the filter is built into the antenna, the patch antenna which added the filter can be miniaturized, and the miniaturization is easy and does not cause degradation of properties, such as narrow-band-izing by miniaturizing, and decline in radiant efficiency.
[0023] In addition, in the patch antenna PA 1 with a built-in filter, it may be made to carry out direct coupling (direct continuation) of the through hole 15 for electric supply, and the dielectric filter 30, without minding capacity.
[0024] Drawing 3 is the sectional view showing the patch antenna PA 2 with a built-in filter which is the 2nd example of this invention.
[0025] The patch antenna PA 2 with a built-in filter is the point of mainly differing from the patch antenna PA 1 with a built-in filter in that the filter 31 is formed in crevice 11c of a base 11.
[0026] namely, the patch antenna PA 2 with a built-in filter -- a base 11 and radiation -- a conductor 12 and touch-down -- a conductor 13, the electric supply terminal 14, the through hole 15 for electric supply, internal electrode pattern 16a, crevice 11c, an inner conductor 17, and the object for external connection -- it has a conductor 19 and the dielectric filter 31 of a chip mold.
[0027] touch-down [in / in crevice 11c / a base 11] -- it is prepared in the part by the side of a conductor 13, and the

dielectric filter 31 of a chip mold is formed inside crevice 11c -- having -- moreover -- radiation -- it is prepared in parallel with a conductor 12. Moreover, most bases of crevice 11c are GND electrodes, and the through hole 15 for electric supply and the dielectric filter 31 are electrically connected inside the base 11. That is, internal electrode pattern 16a has combined the through hole 15 for electric supply, and the chip mold dielectric filter 31.

[0028] In the patch antenna PA 2 with a built-in filter, since each property of the antenna which constitutes it, and a filter can be sorted out according to an individual, the process yield of the patch antenna PA 2 with a built-in filter can be raised. Moreover, since an antenna and a filter can be adjusted as discrete part in the case of the design of the patch antenna PA 2 with a built-in filter, adjustment time amount can be shortened.

[0029] Moreover, although the patch antenna PA 2 with a built-in filter is used mounting in a printed circuit board 21, most parts which mount the patch antenna PA 2 with a built-in filter are the touch-down patterns 22 in that case.

[0030] In addition, in the above-mentioned example, the creation approach of the base ingredient used, an electrode material, and a substrate, the configuration approach of a terminal, etc. are the same as that of the case in the patch antenna PA 1 with a built-in filter.

[0031] You may make it connect electrically the through hole 15 for electric supply, and the dielectric filter 31 on the front face of a base 11 instead of connecting electrically inside a base 11.

[0032] Drawing 4 is the slanting perspective drawing showing the patch antenna PA 3 with a built-in filter which is the 3rd example of this invention.

[0033] Drawing 5 is the perspective view omitting and showing a base 11 in the patch antenna PA 3 with a built-in filter.

[0034] The patch antenna PA 3 with a built-in filter is the point of mainly differing from the patch antennas PA1 and PA2 with a built-in filter in that the antenna is formed in one base 11 2 sets.

[0035] that is, the patch antenna PA 3 with a built-in filter -- a base 11 and radiation -- Conductors 12a and 12b and touch-down -- it has a conductor 13, the through holes 15a and 15b for electric supply, the dielectric filter 32 of a TORIPU rate mold, capacitor electrode pattern 16b, and the short circuit pin 25.

[0036] the through holes 15a and 15b for electric supply -- the interior of a base -- radiation -- connecting with Conductors 12a and 12b, the dielectric filter 32 of a TORIPU rate mold is a filter which has GND18 in a field parallel to the electrodes 12a and 12b for radiation, and is a duplexer or a band splitter. Capacitor electrode pattern 16b is a pattern which carries out capacity coupling of the through holes 15a and 15b for electric supply, and the dielectric filter 32.

[0037] moreover, the case of the patch antenna PA 3 -- radiation -- Conductors 12a and 12b and touch-down -- the short circuit pin 25 is formed between conductors 13, it is made quarter-wave length resonance structure, and the miniaturization is attained. This view is the same as a reverse F-like patch antenna.

[0038] When the dielectric filter 32 is used as the duplexer or band splitter which deals with two or more frequencies, it becomes unnecessary to prepare independently [the patch antenna PA 3] those components that are needed by dual one and the triple device in the patch antenna PA 3. Therefore, the whole set including the patch antenna PA 3 can be miniaturized further.

[0039] In addition, in the patch antenna PA 3, the creation approach of the base ingredient used, an electrode material, and a substrate, the configuration approach of a terminal, etc. are the same as that of the case of the patch antenna PA 1 with a built-in filter.

[0040] Moreover, two or more each of the patch antennas PA1, PA2, and PA3 with a built-in filter may be put in order, and may be used as array antennas.

[0041] Drawing 6 is drawing showing the equal circuit of the patch antenna PA 1 with a built-in filter.

[0042] In the patch antenna PA 1 with a built-in filter, capacity coupling of the antenna section and the filter 30 is carried out.

[0043] Drawing 7 is drawing showing the equal circuit of the patch antenna PA 2 with a built-in filter.

[0044] In the patch antenna PA 2 with a built-in filter, direct continuation of the antenna section and the filter 31 is carried out with the conductor.

[0045] What is necessary is just to choose [from] the optimal thing among the above-mentioned direct continuation and capacity connection according to an impedance, a circumference circuit, a busy condition, etc.

[0046] In the patch antennas PA1, PA2, and PA3 with a built-in filter, as shown in drawing 1 - drawing 5 , by what (it unifies) a filter is built in the interior of a patch antenna for, components and a set can be miniaturized, mounting of an antenna and a filter becomes easy, components mark can be reduced and a design of a set manufacturer becomes easy.

[0047] Moreover, in each above-mentioned example, since a property can be raised since property degradation accompanying the miniaturization of the antenna itself can be suppressed and the big volume can be secured to a filter part, and leading about of wiring can be shortened, property degradation can be suppressed.

[0048] Drawing 8 is drawing explaining the point of "suppressing property degradation accompanying the

miniaturization of the antenna itself" in the above-mentioned example.
[0049] the object [in / on drawing 8 and / the conventional patch antenna PA 10] for radiation -- the magnitude of a conductor 12 becomes abbreviation lambda/(2 and epsilon1/2). on the other hand, the patch antenna PA 2 with a built-in filter -- setting -- GND of a filter 31 -- a conductor 18 and the object for radiation -- since distributed capacity 41 can be constituted between conductors 12 -- the part of this newly generated distributed capacity 41 -- radiation -- area of a conductor 12 can be made small. However, since the place depended on a configuration is large, the engine performance of an antenna cannot prevent property degradation by miniaturization completely.
[0050] by the way, radiation -- bending a conductor 12 **** -- radiation -- the technique of the miniaturization by putting slitting into a conductor 12 -- the above-mentioned example -- radiation -- a conductor -- since the condition of 12 the very thing can secure the condition near a square in a flat, degradation of a property can be suppressed to the minimum.
[0051] radiation -- in order to earn capacity, with the condition of a conductor 12 maintained -- touch-down -- it is surely necessary to lift a conductor 13 for example, the patch antenna PA 1 with a built-in filter shown in drawing 2 -- setting -- touch-down -- the GND electrode 18 raises from a conductor 13 -- having -- this lifted GND electrode 18 and radiation -- the joint capacity 41 occurs between conductors 12. in this case, the GND electrode 18 which can be set . and touch-down -- the tooth space between conductors 13 is used and the dielectric filter 30 is formed.
[0052] In this case, capacity 41 can be ideally constituted between the electrode 12 for radiation, and the GND electrode 18 by constituting the field of the electrode 12 for radiation, and the GND electrode 18 of the dielectric filter 30 built in in parallel. That is, capacity 41 can be more efficiently constituted to occupied volume and area.
[0053] Filters 31 and 32 are formed and the patch antennas PA2 and PA3 with a built-in filter consist of the same ideas as the above.
[0054] Moreover, about a point [the above "since the big volume can be taken into a filter part, a property can be raised"], since low loss is required, as for the filter of the front end of mobile communications, high Q is usually required of the resonator section. It being the most effective as an approach of raising Q is securing sufficient magnitude. However, since sufficient tooth space for an actual set is not securable, the present condition is designing by surely low Q.
[0055] Since one side is Abbreviation lambda / 2, the vacant tooth space in the interior of that patch antenna of the patch antenna which consists of dielectrics from the first by adopting the structure of the above-mentioned example about this point is quite large, and this free space can be secured as a filter.
[0056] By this, since the die length of the resonator part of the dielectric filter 31 can be brought more close to lambda/4, higher Q value can be obtained. The property of a dielectric filter can be raised by this.
[0057] Moreover, about a point [the above "since leading about of wiring can be shortened, property degradation can be suppressed"], if the filter of a front end is constituted inside an antenna, since the distance between them can be set as the minimum, degradation of a property can be suppressed to the minimum.
[0058] Moreover, since each property can be sorted out by adopting the structure of mounting the filter 31 of a chip mold from a rear face as shown in drawing 3 , the process yield can be raised. Moreover, since adjustment with discrete part is attained in the case of a design, a design time can be shortened.
[0059] Moreover, dual-izing of a patch antenna and broadband-ization can be performed, securing the above-mentioned effectiveness by making an antenna into the structure more than dual, as shown in drawing 4 and drawing 5 .
[0060] Furthermore, since it becomes unnecessary to prepare for any parts other than patch antenna [with a built-in filter] PA1 and PA2, and PA3 those components that are needed by dual one and the triple device by using a dielectric filter as a duplexer or a band splitter, a set including a patch antenna with a built-in filter can be miniaturized further. Moreover, the isolation of the transmission and reception in radio and the isolation between dual bands can be raised.
[0061]
[Effect of the Invention] According to this invention, the patch antenna which added the filter can be miniaturized easily, and the effectiveness of not causing degradation of properties, such as narrow-band-izing accompanying a miniaturization and decline in radiant efficiency, is done so.

[Translation done.]

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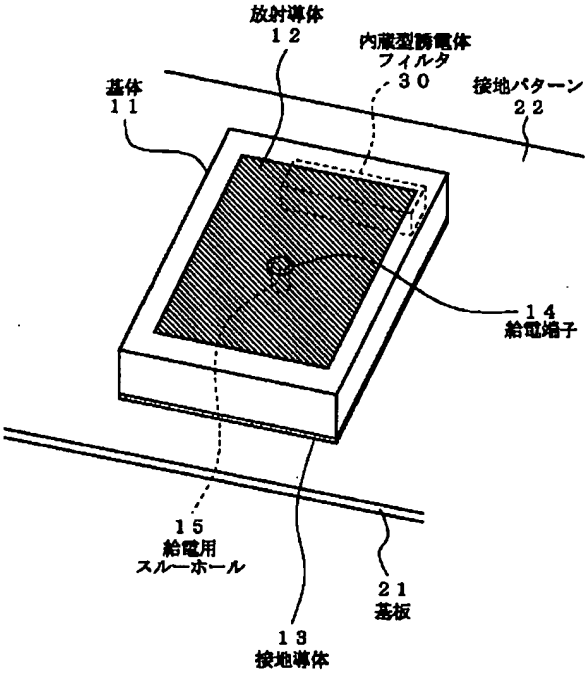
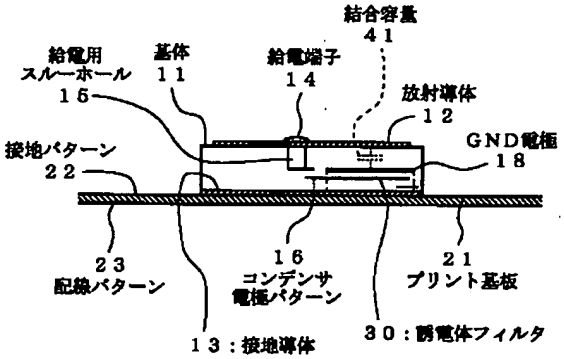
DRAWINGS

[Drawing 1]
PA1：フィルタ内蔵パッチアンテナ

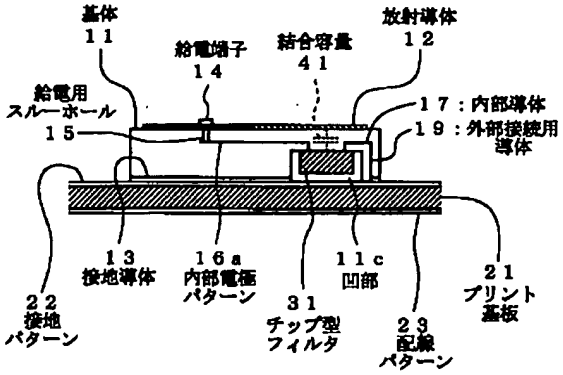


[Drawing 2]
PA1：フィルタ内蔵パッチアンテナ



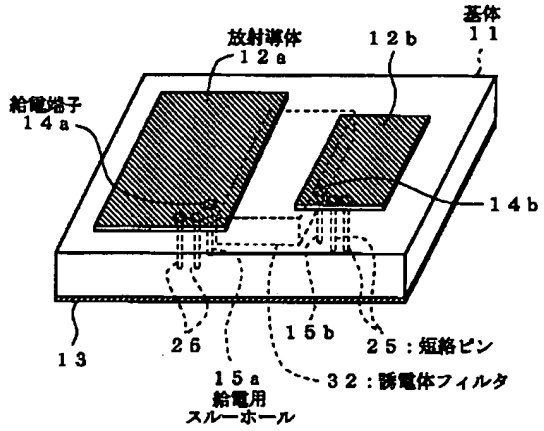
[Drawing 3]

PA2：フィルタ内蔵パッチアンテナ



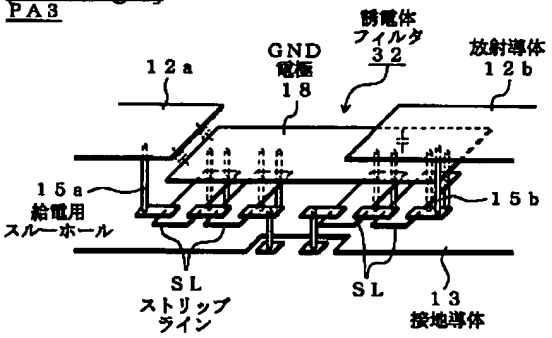
[Drawing 4]

PA3：フィルタ内蔵パッチアンテナ



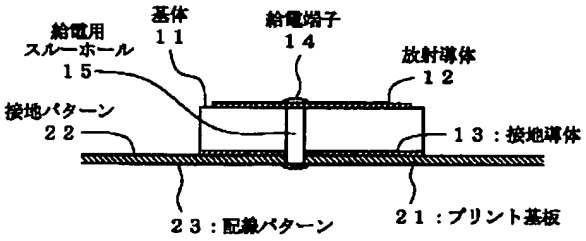
[Drawing 5]

PA3



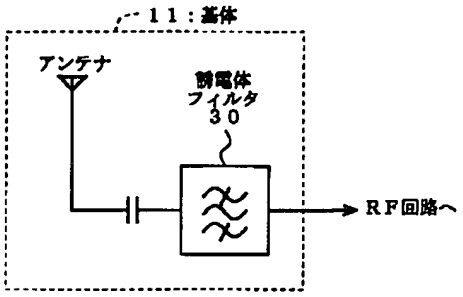
[Drawing 10]

PA10



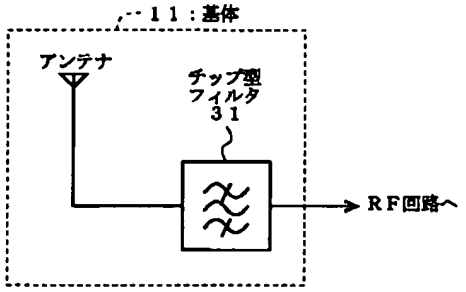
[Drawing 6]

フィルタ内蔵パッチアンテナＰＡ１の等価回路（容量結合）



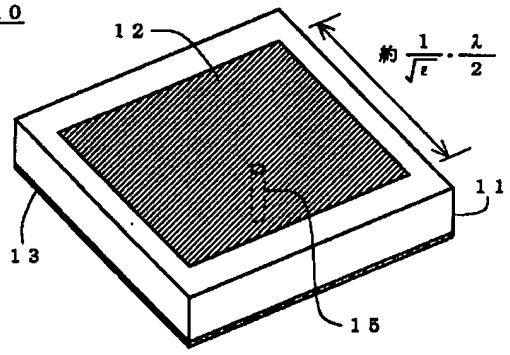
[Drawing 7]

フィルタ内蔵パッチアンテナＰＡ２の等価回路（直接結合）

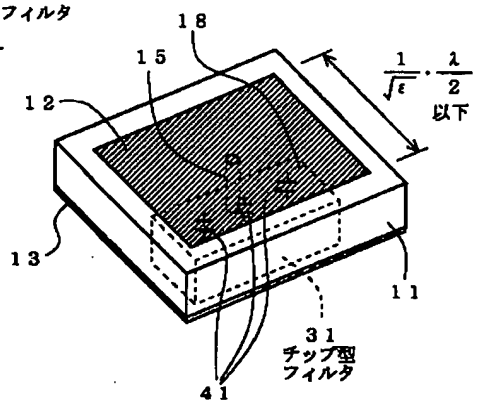


[Drawing 8]

従来のフィルタ
ＰＡ１０

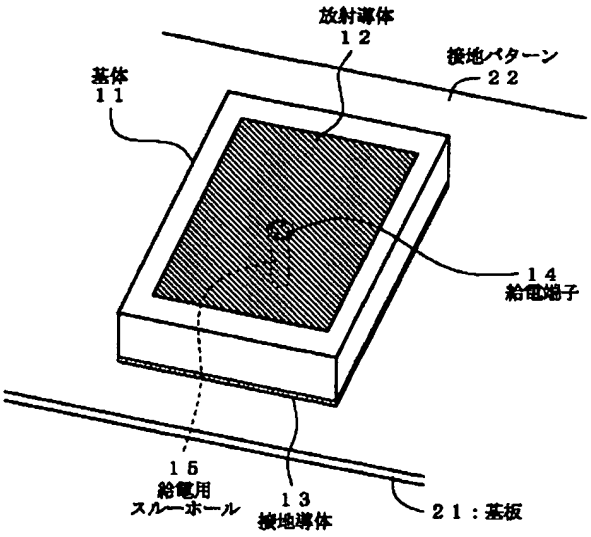


実施例のフィルタ
ＰＡ２



[Drawing 9]

PA10：従来のパッチアンテナ



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